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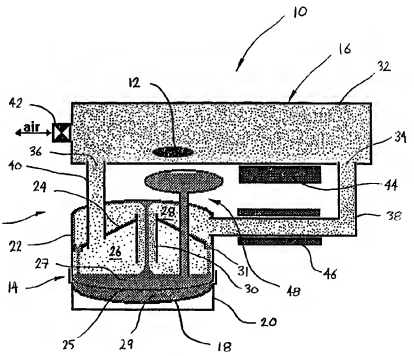
(54) Title: A STERILISATION APPARATUS

(57) Abstract

The present invention relates generally to a sterilisation apparatus (10) designed to receive an article (12) requiring sterilisation. The sterilisation apparatus (10) comprises an aerosol generator (14) operatively coupled to a sterilisation chamber (16). The aerosol generator (14) includes an ultrasonic transducer (18) which is electrically coupled to an ultrasound generator. The sterilisation apparatus also includes a tube (30) which passes vertically through an apex of a partition ceiling (24) formed in a nebulisation chamber (22) of the aerosol generator (14). The sterilisation chamber (16) includes a sterilisation container (32) which houses the article (12) to be sterilised. The container (32) includes an aerosol inlet (34) and an aerosol outlet (36) in communication with an expansion cavity (28) and nebulisation cavity (26) of the nebulisation chamber (22) via an aerosol inlet conduit (38) and an aerosol outlet conduit (40) respectively. The sterilising agent is nebulised via the transducer (18) and recirculated through the sterilisation chamber (16). Condensation of the aerosol is promoted within the sterilisation chamber (16) by another ultrasonic transducer (44) or by heating of the aerosol via a heater (46).



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A STERILISATION APPARATUS

The present invention relates generally to a sterilisation apparatus and a method of sterilisation and relates particularly, though not exclusively, to sterilisation involving ultrasonic nebulisation of a sterilising agent such as hydrogen peroxide.

It is recognised that the sterilisation of equipment can be achieved by exposing the equipment to an ultrasonically nebulised sterilising agent such as hydrogen peroxide. The sterilising agent is provided as an aerosol which effectively penetrates crevices, pores and other portions of the equipment which otherwise are not accessible by sterilising agent in a liquid form.

Several US patents including US 4,424,189 (Hick), US 4,797,255 (Hatanaka *et al*), and US 4,512,951 (Koubek) disclose the heating of a sterilising agent to effect evaporation of the sterilising agent which in its gaseous form is then contacted with the equipment to be sterilised. Although the gaseous sterilising agent is effective in penetrating the equipment the apparatus covered by these patents have the following drawbacks:

i) the apparatus is generally complicated in construction;

ii) the apparatus must be formed of materials resistant to the relatively high temperatures at which it is operated; and

iii) the choice of sterilising agents is restricted by the relatively high operating temperature.

Other US patents including US 4,680,163 (Blidschun *et al*) and US 4,366,125 (Kodera) describe ultrasonic nebulisation of a sterilising agent at ambient temperature. In these examples of the prior art an aerosol of the sterilising agent may condense on the equipment for effective

sterilisation in the liquid form. However, the sterilising agent within the aerosol is of a low concentration as it is diluted with a carrier gas and/or the flow of the carrier gas and the aerosol is intermittent.

An intention of the present invention is to provide a sterilisation apparatus and a method of sterilisation that in operation are relatively effective.

According to one aspect of the present invention there is provided a sterilisation apparatus comprising:

an aerosol generator being adapted to generate an aerosol of a sterilising agent; and

a sterilisation chamber operatively coupled to the aerosol generator so as to receive a recirculatory flow of the aerosol, the sterilisation chamber being designed to receive an article requiring sterilisation whereby in operation the recirculatory flow of the aerosol through the sterilisation chamber is effective in sterilising the article.

According to another aspect of the present invention there is provided a sterilisation chamber being adapted to receive an article requiring sterilisation, the sterilisation chamber including an inlet and an outlet being configured to receive a recirculatory flow of an aerosol of a sterilising agent whereby in operation the recirculatory flow of the aerosol through the sterilisation chamber is effective in sterilising the article.

Generally the aerosol generator includes an ultrasonic transducer operatively coupled to or forming part of a reservoir which is adapted to contain the sterilising agent.

Preferably the sterilisation apparatus further comprises a tube positioned above the reservoir, the ultrasonic

transducer being effective in producing a fountain of the sterilising agent into an inlet of the tube where the aerosol is produced. It is understood that the aerosol is produced from a lower part of the fountain and the kinetic energy of the fountain within the tube increases the static pressure of the aerosol within the tube thereby inducing a pressure drop across the tube which alone serves to propel the aerosol.

Typically an outlet of the tube is coupled to or defines the inlet of the sterilisation chamber. More typically the outlet of the sterilisation chamber is coupled to or defines an air inlet, the aerosol being propelled through the tube under the assistance of air being drawn through the air inlet.

Preferably the apparatus further comprises means for effecting condensation of the aerosol within or on the article. Typically said means includes one or more of the following contrivances:

i) a heating element operatively coupled to the inlet of the sterilisation chamber;

ii) an ultrasonic transducer operatively coupled to the sterilisation chamber; and/or

iii) a device for increasing the pressure of aerosol within the sterilisation chamber.

Typically the apparatus also comprises means for rinsing and/or drying the condensed aerosol within or on the sterilisation chamber together with the article. Generally said rinsing and/or drying means is of a conventional construction.

Typically the aerosol generator and/or the sterilisation chamber are of a disposable design.

According to a further aspect of the present invention there is provided a method of sterilisation comprising the steps of:

providing a sterilisation apparatus including an aerosol generator and a sterilisation chamber operatively coupled to each other;

locating an article requiring sterilisation in the sterilisation chamber; and

providing a recirculatory flow of an aerosol of a sterilising agent through the sterilisation chamber whereby in operation the recirculatory flow of the aerosol through the sterilisation chamber is effective in sterilising the article.

Preferably the method of sterilisation further comprises the step of condensing the aerosol within or on the article. More preferably the method additionally includes the step of rinsing and drying the aerosol having been condensed within or on the article.

Generally the sterilising agent includes hydrogen peroxide or a derivative thereof.

According to yet another aspect of the present invention there is provided a switching device being designed to activate upon detection of a low level of liquid within a reservoir, the switching device comprising a cavitation signal detector operatively coupled to an ultrasound generator which is electrically coupled to an ultrasonic transducer located adjacent or defining the reservoir, the cavitation signal detector being configured to deactivate the ultrasound generator upon detection up to a threshold level of cavitation wherein there is sufficient liquid within the reservoir.

Preferably the switching device also comprises a filter electrically coupled to and located "upstream" of the

cavitation signal detector, the filter being designed to filter all or part of the cavitation signal whereby said filtered portion only passes to the cavitation signal detector.

Typically the switching device also includes a blocking signal generator electrically coupled to a delay line which together operatively cooperate with the switching device to deactivate it when there is no cavitation.

Sterilisation is to be understood as including higher level disinfection.

In order to achieve a better understanding of the nature of the present invention a preferred embodiment of a sterilisation apparatus, a method of sterilisation and a switching device will now be described in some detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a schematic sectional view of one embodiment of a sterilisation apparatus;

Figure 2 is a schematic sectional view of another embodiment of a sterilisation apparatus;

Figure 3 is a schematic sectional view of a further embodiment of a sterilisation apparatus; and

Figure 4 is a diagrammatic representation of one embodiment of a switching device.

As shown in Figures 1 to 3 there are various embodiments of a sterilisation apparatus shown generally as 10 being designed to receive an article 12 requiring sterilisation. For ease of reference the same numerals are used to designate like or similar components of the various apparatus 10.

The sterilisation apparatus 10 comprises an aerosol generator 14 operatively coupled to a sterilisation chamber

16. In these embodiments the aerosol generator 14 includes an ultrasonic transducer 18 which is electrically coupled to an ultrasound generator (not shown). The remainder of the aerosol generator 14 is similar in construction to that described in the applicant's International patent publication No. WO 94/08727. The ultrasonic transducer 18 is mounted within a transducer housing 20 which can be any form but in this example is generally cylindrical in shape with a circular base. The transducer housing 20 is connected to a nebulisation chamber 22 which includes a conical-shaped partition ceiling 24 and a dish-shaped base 25 configured to hold a sterilisation agent 27 such as hydrogen peroxide, gluteraldegide or formaldegide etc. A liquid transfer media 29 such as water locates between the transducer 18 and the dish-shaped base 25. Thus, a nebulisation and expansion cavity 26 and 28 is located beneath and above, respectively, the ceiling 24. The nebulisation chamber 22 is also cylindrical with a dome-shaped roof. The nebulisation chamber 22 and/or the sterilisation chamber 16 may be of a disposable design.

Importantly the sterilisation apparatus 10 further includes a tube 30 which passes vertically through an apex of the partition ceiling 24. The tube 30 can have any cross-section but in this example is of a circular cross-section throughout its length with an inlet disposed coaxially within the nebulisation cavity 26 above the ultrasonic transducer 18. An outlet of the tube 30 is located within the expansion chamber 28. The ceiling 24 also includes one or more drainholes 31 located in its periphery.

The sterilisation chamber 16 includes a sterilisation container 32 which may be of any shape suitable for housing the article 12 to be sterilised. The container 32 includes an aerosol inlet 34 and an aerosol outlet 36 formed in its bottom wall. The aerosol inlet 34 is in fluid communication with the expansion cavity 28 via aerosol

inlet conduit 38. The aerosol outlet 36 is in communication with the nebulisation cavity 26 via an aerosol outlet conduit 40. The inlet conduit 38 passes through the domed roof only of the nebulisation chamber 22 whereas the outlet conduit 40 passes through both the domed roof and the partition ceiling 24.

The sterilisation apparatus 10 of Figures 1 and 2 include additional features such as an air valve 42 mounted to the sterilisation container 32 being designed to permit pressurisation of the container 32. The sterilisation apparatus 10 of Figures 2 and 3 also includes:

(i) an additional ultrasonic transducer 44 operatively coupled to the sterilisation container 32;

(ii) a heater 46 in heat conductive communication with the inlet conduit 38; and

(iii) a riser tube and tank assembly 48 located immediately above the sterilising agent 27 with the tank extending outside the expansion chamber 22.

The riser tube and tank assembly 48 maintains a constant level of sterilising agent during nebulisation so as to achieve an improved efficiency whereby the aerosol is generated within the tube 30. However, the sterilisation apparatus need not include the riser tube assembly.

It is the applicant's intention to construct the sterilisation chamber 16 and possibly the aerosol generator 14 as a disposable design. In this example the sterilisation container 32 will be constructed of a plastics material and releasably fits to the inlet and outlet conduits 38 and 40 as a socket-fit. In another example as illustrated in Figure 3 the aerosol generator may be of a non-disposable design.

In operation sterilisation of the article 12 is effected by three general steps, namely:

(i) the sterilising agent is nebulised via activation of the transducer 18 whereby an aerosol of the sterilising agent is recirculated through the sterilisation chamber 16 and returned to the aerosol generator 14;

(ii) condensation or coagulation of the aerosol is promoted within the sterilisation chamber 16 by activation of the other ultrasonic transducer 44; and

(iii) the sterilisation chamber 16 and article 12 are rinsed and dried by conventional techniques.

Condensation of the aerosol may also be promoted by locating a heater 46 about the inlet conduit 38 of the apparatus 10. This heater 46 is designed to heat the aerosol which encourages condensation of aerosol on or within the article 12. Alternatively or additionally the sterilisation chamber 16 may be pressurised via the air valve 42 to promote condensation of the aerosol.

As disclosed in International patent publication number WO 94/08727, which is included herein by way of reference, the ultrasonic transducer 18 produces a fountain of the sterilising agent within an inlet of the tube 30 where the aerosol is produced. It is understood that the kinetic energy of the fountain moving together with the aerosol within the tube 30 increases the static pressure of the aerosol within the tube 30 thereby inducing a pressure drop across the tube 30 which alone serves to propel the aerosol. The aerosol is sucked through the tube 30 as the fountain and aerosol together move through the tube 30 like a "piston" so as to recirculate the aerosol through the sterilisation chamber 16. Any aerosol which condenses within the expansion cavity 28 or liquid which passes into the cavity 28 passes along the partition ceiling 24 and through the drainholes 31 into the nebulisation chamber 26.

Additionally any sterilising agent not converting to an aerosol will return to the reservoir of sterilising agent,

via the tube 30, within the nebulisation chamber 22.

Recirculation of the sterilising agent in the aerosol form through the container 32 or sterilising chamber 16 ensures that substantially full coverage and penetration of the article 12 with the aerosol is achieved. In order to then obtain effective sterilisation of the article 12 the aerosol is condensed via the further ultrasonic transducer 44, the heater 46 and/or pressurisation of the container 32 via the air valve 42. In each case the relatively cool article 12 promotes the condensation of aerosol for liquid disinfection or sterilisation of the article 12. Advantageously sterilisation of the article 12 is conducted at ambient temperature and pressure whereby condensation is made possible to promote sterilisation of the article 12. The further ultrasonic transducer 44 can also be activated for presterilising ultrasonic cleaning of the article 12.

It will be appreciated that damage to the transducer 18 can occur when the aerosol generator 14 is not filled or replenished with sterilising agent. Conventionally transducers such as piezoceramic transducers are protected from damage using temperature, capacitance or other sensors. These sensors are incorporated as an additional element and this involves extra cost.

It is recognised that the generation of aerosols is accompanied by cavitation which is a non-linear process. The spectrum of frequencies present during the cavitation do not exist in the fundamental voltage applied to a transducer. The frequency spectrum includes not only the fundamental frequency of generation but also noise of cavitation and sub-harmonics.

According to a further aspect of the present invention, an embodiment of which is illustrated in Figure 4, a signal from a piezoceramic transducer 50 passes through a filter

54 and a detector 56 to a switch 58. The switch 58 controls the on-off operation of an ultrasonic generator 52. Cavitation of a liquid, such as a sterilising agent, via the transducer 50 will not be detected until shortly after it occurs. Therefore, the switch 58 must remain on for a brief initial period of operation. Therefore, a delay line 62 introduces this period of delay time so that a blocking signal generator 60 passes through the delay line 62 and turns the switch 58 off unless a signal is received from detector 56 indicating cavitation. The blocking signal from the generator 60 starts simultaneously with the voltage from the ultrasonic generator 52.

When liquid in the nebulisation chamber is present, cavitation occurs and the piezoceramic transducer 50 receives the cavitation signal. The signal is passed through the filter/filters 54 and the detector 56 to the switch 58. The switch 58 will not change the on state of the ultrasonic generator 52 and voltage is applied to the piezoceramic transducer 50. If liquid in the nebulisation chamber is not available, the signal of cavitation does not pass to the filter 54 and the switch 58 and hence the switch 58 turns off the ultrasonic generator 52 via the blocking signal.

In this embodiment the switching device comprises the filter 54, detector 56, switch 58, and delay line 62. It should be appreciated that the switching device may exclude specific components of this embodiment or include additional components depending on the application.

Now that preferred embodiments of the present invention have been described in some detail it will be apparent to those skilled in the art that the sterilisation apparatus, method of sterilisation, and switching device have at least the following advantages:

(i) effective sterilisation is produced by a

combination of penetration of the aerosol together with condensation of the aerosol on the articles surface;

(ii) the consumption of sterilising agent in its aerosol form is relatively low;

(iii) the additional energy imparted to aerosol particles significantly increases the surface energy of the sterilising agent and its sterilising activity; and

(iv) effective protection of the transducer can be achieved without requiring additional sensors.

Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. For example, the sterilisation apparatus may include more than one aerosol generator. In this instance each of the aerosol generators may produce an aerosol form of different sterilising agents. These aerosols may be applied simultaneously or consecutively in a programmed sequence to the article to be sterilised. Due to the synergy between different sterilising agents the efficiency of the sterilisation process can be significantly increased.

Although it is preferred that nebulisation of the sterilising agent is achieved using an ultrasonic transducer, other means of nebulisation such as heating are within the ambit of the present invention. The invention is not restricted to hydrogen peroxide as a sterilising agent but rather extends to any liquid solution having sterilising properties. The transducer 18 itself, rather than the base of the nebulisation chamber, may be designed to contain the sterilisation agent. Air may be forced into the sterilisation container 32 to promote condensation of the aerosol or conversely air may be drawn from the container 32 to assist in drying of the article. Drying may also be effected by acoustical vibration. For example, this may be effected by the transducer where there is no sterilising agent present. An absorbent system may be

included in a return line to the aerosol generator to absorb condensed aerosol. The aerosol may be electrically charged and controls by electro, magnetic or electro-magnetic fields to enhance the efficiency of sterilisation.

The aerosol generator may be coupled to a breathing ventilation system which constitutes the sterilisation chamber. The breathing ventilation system may include a child's incubator, a ventilator, or an apparatus for treating sleep apnoea.

The switching device may detect the low level of any liquid within a reservoir and is not restricted to sterilising agents.

All such variations and modifications are to be considered within the scope of the present invention the nature of which is to be determined from the foregoing description.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A sterilisation apparatus comprising:

an aerosol generator being adapted to generate an aerosol of a sterilising agent; and

a sterilisation chamber operatively coupled to the aerosol generator so as to receive a recirculatory flow of the aerosol, the sterilisation chamber being designed to receive an article requiring sterilisation whereby in operation the recirculatory flow of the aerosol through the sterilisation chamber is effective in sterilising the article.

2. A sterilisation apparatus as defined in claim 1 wherein the aerosol generator includes an ultrasonic transducer operatively coupled to or forming part of a reservoir which is adapted to contain the sterilising agent.

3. A sterilisation apparatus as defined in claim 2 further comprising a tube positioned above the reservoir, the ultrasonic transducer being effective in producing a fountain of the sterilising agent into an inlet of the tube where the aerosol is produced.

4. A sterilisation apparatus as defined in any one of the preceding claims wherein the sterilisation chamber includes an inlet and an outlet operatively coupled to the aerosol generator so as to provide the recirculatory flow of the aerosol through the sterilisation chamber.

5. A sterilisation apparatus as defined in claim 4 wherein an outlet of the tube is coupled to or defines the inlet of the sterilisation chamber.

6. A sterilisation apparatus as defined in claim 4 or 5 wherein the outlet of the sterilisation chamber is

coupled to or defines an air inlet, the aerosol being propelled through the tube under the assistance of air being drawn through the air inlet.

7. A sterilisation apparatus as defined in any one of the preceding claims further including a partition ceiling located above the sterilising agent, the ceiling including one or more drain holes which permit recycling of condensed aerosol or liquid sterilising agent to the aerosol generator.

8. A sterilisation apparatus as defined in any one of the preceding claims further comprising means for effecting condensation of the aerosol within or on the article.

9. A sterilisation apparatus as defined in claim 8 wherein said means includes one or more of the following contrivances:

i) a heating element operatively coupled to the inlet of the sterilisation chamber;

ii) an ultrasonic transducer operatively coupled to the sterilisation chamber; and/or

iii) a device for increasing the pressure of aerosol within the sterilisation chamber.

10. A sterilisation apparatus as defined in any one of the preceding claims also comprising means for rinsing and/or drying the condensed aerosol within or on the sterilisation chamber together with the article.

11. A sterilisation apparatus as defined in any one of the preceding claims wherein the aerosol generator and/or the sterilisation chamber are of a disposable design.

12. A method of sterilisation comprising the steps

of:

providing a sterilisation apparatus including an aerosol generator and a sterilisation chamber operatively coupled to each other;

locating an article requiring sterilisation in the sterilisation chamber; and

providing a recirculatory flow of an aerosol of a sterilising agent through the sterilisation chamber whereby in operation the recirculatory flow of the aerosol through the sterilisation chamber is effective in sterilising the article.

13. A method of sterilisation as defined in claim 12 further comprising the step of condensing the aerosol within or on the article.

14. A method of sterilisation as defined in claim 13 additionally including the steps of rinsing the aerosol having been condensed within or on the article and thereafter drying the article.

15. A method of sterilisation as defined in claim 14 wherein drying of the article involves activating an acoustical transducer whereby a flow of air passes through the sterilisation chamber to effect drying of the article.

16. A sterilisation apparatus or a method of sterilisation as defined in any one of the preceding claims wherein the sterilising agent includes hydrogen peroxide or a derivative thereof.

17. A switching device being designed to activate a an ultrasonic generator upon detection of a low level of liquid within a reservoir, the switching device comprising a cavitation signal detector operatively coupled to the ultrasonic generator which is electrically coupled to an ultrasonic transducer located adjacent or defining the

reservoir, the cavitation signal detector being configured to activate the ultrasound generator upon detection up to a threshold level of cavitation wherein there is sufficient liquid within the reservoir.

18. A switching device as defined in claim 17 also comprising a filter electrically coupled to and located "upstream" of the cavitation signal detector, the filter being designed to filter all or part of the cavitation signal whereby said filtered portion only passes to the cavitation signal detector.

19. A switching device as defined in claim 17 or 18 further comprising a blocking signal generator electrically coupled to a delay line which together operatively cooperate with the switching device to deactivate it when there is no cavitation.

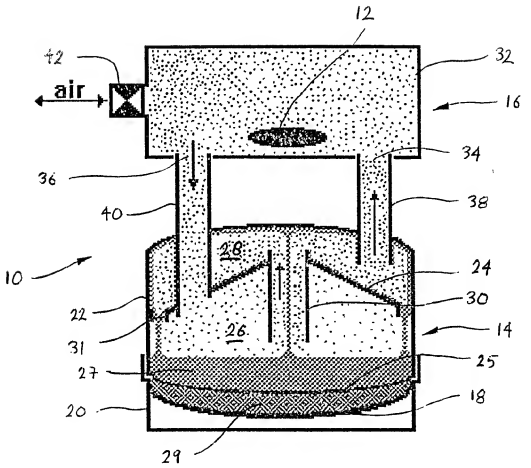

FIG. 1

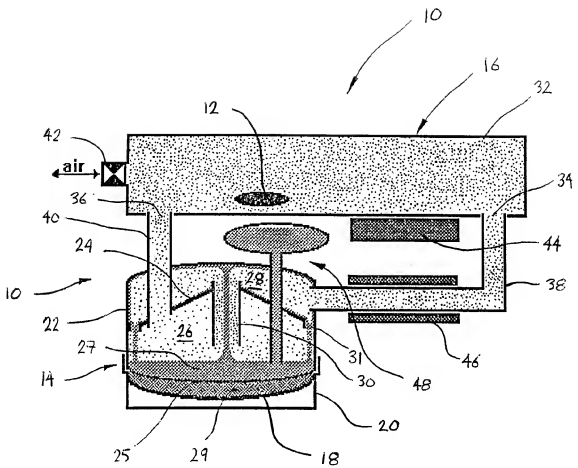
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FIG. 2

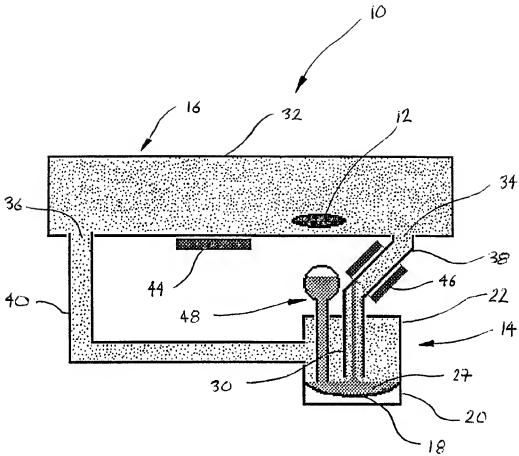

FIG. 3

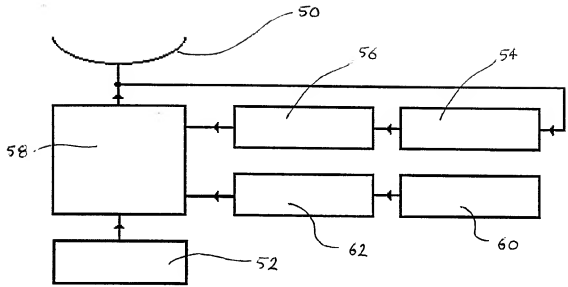

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00089

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: A61L 2/22, G01F 23/28, B08B 3/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: A61L 2/22, 2/24, 2/02, 2/04, 2/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT: IPC as above

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 475505 A1 (DUPHAR INTERNATIONAL RESEARCH B.V) 18 March 1992 Whole document	1, 4, 12, 16
A	Derwent Abstract Accession No 97-239592/22, Class D22, JP 09075432-A (EWA YG) 25 March 1997 Abstract	1, 2, 7, 8, 12
X	Derwent Abstract Accession No. 93-043359/05, Class S03, SU 1717054 A (MARTYNYUK) 7 March 1992 Abstract	17-19

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 March 1999	12 APR 1999
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	Authorized officer **GAYE HOROBIN** Telephone No.: (02) 6283 2069

Form PCT/ISA/210 (second sheet) (July 1998) copsaa

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00089

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3490697A (BEST Jr.) 20 January 1970 Abstract	17-19
A	US 4673927 A (CIANCIAVICCHIA et al) 16 June 1987 Whole document	17-19

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00089

Box 1 Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. Claims 1-16 directed to a sterilisation apparatus and a method of sterilisation.

2. Claims 17-19 directed to a switching device designed to activate an ultrasonic generator.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU 99/00089

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
EP	475505	JP	4253624	DAU	82428/91		
US	4673927	CA	1256978	EP	180526	JP	61117437

END OF ANNEX